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Co-morbidity obese children in family practice in The Netherlands: the results of a pilot study

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Objectives. The aim of this pilot study was to assess the prevalence of co-morbidity in obese children. Particular emphasis was on cardiovascular risk.

Method. In this retrospective, cross-sectional, observational study the data of 155 obese children, who visited a paediatric obesity outdoor clinic, have been studied.

Results. In all, 92% of the population had at least one cardiovascular risk factor. In all, 48% showed a high systolic and 9% a high diastolic blood pressure, while 18% had an increased fasting glucose. In 60%, we diagnosed insulin resistance: the homeostasis model assessment was elevated.

Discussions. The prevalence of high blood pressure, dyslipidaemia, abnormal fasting glucose and insulin resistance are high in this retrospective study. Outcomes of foreign studies on this object are difficult to compare because various populations and cut-off points are used. A new, prospective, study will be conducted to assess the prevalence of co-morbidity in obese children in general practice.

Keywords. Children, co-morbidity, general practice, obesity, insulin resistance.

Introduction

Obesity is increasing worldwide. Since the effects of intervention in adult obesity are disappointing, prevention of adult obesity is in our opinion the approach of choice. This prevention strategy should start in childhood. In 2002, the prevalence of childhood obesity in Europe had already exceeded the predicted peak for 2010.¹ The prevalence of childhood obesity in The Netherlands in 2003 was 2.6% of the boys and 3.3% of the girls, still relatively low but increasing in comparison with 1997.² Childhood obesity is not only a risk factor for adult obesity,³ but associated with hypertension, dyslipidaemia and insulin resistance as well.^{4,5}

In The Netherlands, a multidisciplinary task force group of the Dutch Institute for Healthcare Improvement (CBO) (including general practice) has developed an evidence-based guideline on primary and secondary prevention of obesity.⁶ In this guideline, the Dutch GPs are asked to actively diagnose and engage obese children. Currently, we are preparing

a primary care-based multidisciplinary project on childhood obesity on the basis of this guideline. An important element of this guideline is its focus on co-morbidity. However, the prevalence of co-morbidity in obese children in the general practice population, assumed to be high, has never been studied in The Netherlands. In our view, it would stimulate GPs participation in the guideline, when empirical evidence of co-morbidity in obese children in their practices would be available. We report here a pilot study that aimed to assess the prevalence of co-morbidity in obese children who had been diagnosed by their GP and/or youth health care. Particular emphasis was on cardiovascular risk (high blood pressure, dyslipidaemia, fasting glucose and insulin resistance).

Patients and materials

In Amersfoort (a city in the centre of The Netherlands, 135 000 inhabitants), an alliance formed by

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youth health care, paediatricians and GPs has already developed a regional protocol for obese children in 2005 in which an obesity outdoor clinic of the Meander Medical Centre Amersfoort (Poli X) served as the facility to supervise care and support of all obese children and their parents.⁷ This is the only paediatric outdoor clinic specialized in childhood obesity in the region.

Participants

For this study, we analysed the data of the first 155 patients that had been included in the project (60 boys and 95 girls, 57% Dutch origin and 43% immigrants). The inclusion criteria were the diagnosis obesity and the age of 2–18 years. The patients had been recruited by their GP or by youth health care and they visited Poli X between November 2005 and July 2007.

Methods

Of each child, weight, height, body mass index (BMI), BMI-standard deviation score (SDS), blood pressure, fasting glucose, fasting insulin, homeostasis model assessment (HOMA), fasting triglycerides, fasting low-density lipoprotein cholesterol (LDL-c) and fasting high-density lipoprotein cholesterol (HDL-c) were measured according to the Poli X protocol. This protocol is summarized in Table 1 and is almost similar to the CBO protocol.

BMI. Height and weight (both Seca scales) had been measured and BMI was calculated. Obesity was defined according to the 97th percentile using population-specific data in concordance with the definition of obesity of the International Task Force of Obesity.⁸ In contrast to adults, in children and adolescents the cut-off points for BMI depend on age and sex.

BMI-SDS. BMI-SDS according to Dutch reference.⁹

Blood pressure. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured at the right arm after a 5-minute rest in a seated position.

The correct cuff had to be used for the length and circumference of the right upper arm: at least a third of the upper arm had to be covered. If the result was high (>P95), the procedure was repeated twice. The lowest result has been used for the study. Blood pressure was corrected for age, gender and height.¹⁰

Blood samples. Blood samples were obtained by a trained laboratory technician in the laboratory of the Meander Medical Centre in Amersfoort. Instruction had been given to fast for at least 8 hours. Fasting glucose, fasting insulin and fasting lipids were measured. We have used laboratory techniques and cut-off points according to the guidelines of Poli X (Table 2).

Insulin resistance. The insulin resistance was assessed by the formula¹¹:

$$\text{HOMA} = \frac{\text{insulin (milli units per liter)} \times \text{glucose (mM)}}{22.5}$$

Results

The mean age was 10.8 years (range 3.1–18.6) and the mean BMI-SDS 2.8 (range 2.0–4.6). Children and parents were very cooperative. None of the children refused examination. There are some missing data: blood pressure ($n = 10$) and results of fasting glucose ($n = 2$) and fasting insulin ($n = 13$). Of the 155 children, 92% had at least one cardiovascular risk factor. We diagnosed one cardiovascular risk factor in 93% of the autochthon children (mean BMI-SDS 2.76) and in 89% of the immigrant children (mean BMI-SDS 2.91). In 48%, a high SBP and in 9% a high DBP was found, while 18% had an increased fasting glucose. In 60%, the HOMA was elevated. The results are shown in Figure 1.

TABLE 2 Laboratory tests and cut-off points according to protocol Poli X, Meander Medical Centre Amersfoort

Test Poli X		Cut-off point Poli X
HDL	Homogeneous direct analysis (Beckman Coulter LXi)	1.1
LDL	Calculation Friedewald (Beckman Coulter LXi)	4
TG	Enzymatic analysis (GPO-trinder) (Beckman Coulter LXi)	1.5
Chol	Enzymatic analysis (Beckman Coulter LXi)	6–12 years: 5.5 12–18 years: 6.5
Insulin	Chemoluminescence assay (Immolute 2000)	–
Glucose	Enzymatic analysis with glucose oxidase (Beckman Coulter LX)	5.6
HOMA		3.1

TABLE 1 Summary protocol Poli X, Meander Medical Centre Amersfoort

<p>Form Poli X</p> <p>Date:</p> <p>Paediatrician:</p> <p>Referred by: Youth Health Care/GP/Specialist</p> <p>Weight: Length:</p> <p>BMI: overweight/obesity</p> <p>SBP: (p95=.....) DBP: (p95=.....)</p> <p>Puberty:</p> <p>Weight circumference:</p> <p>Risk factors:</p> <p>Family: DM2 +/- CVD +/- hypertension +/- cholesterol +/-</p> <p>Dutch/ Turkish/Moroccan/Different</p> <p>Dysmature +/- Acanthosis nigricans +/- Hypertension +/-</p> <p>PCOS/premature puberty +/- OSAS +/-</p> <p>Conclusion: normal weight/overweight/obesity</p> <p>Laboratory: Date:</p> <p>Fasting glucose..... Glucose 2 hours..... Fasting insulin.....</p> <p>Cholesterol....., HDL....., LDL....., TG.....</p> <p>ALAT..... Vitamin D....., DHEAS....., Free androgen....., TSH.....</p>

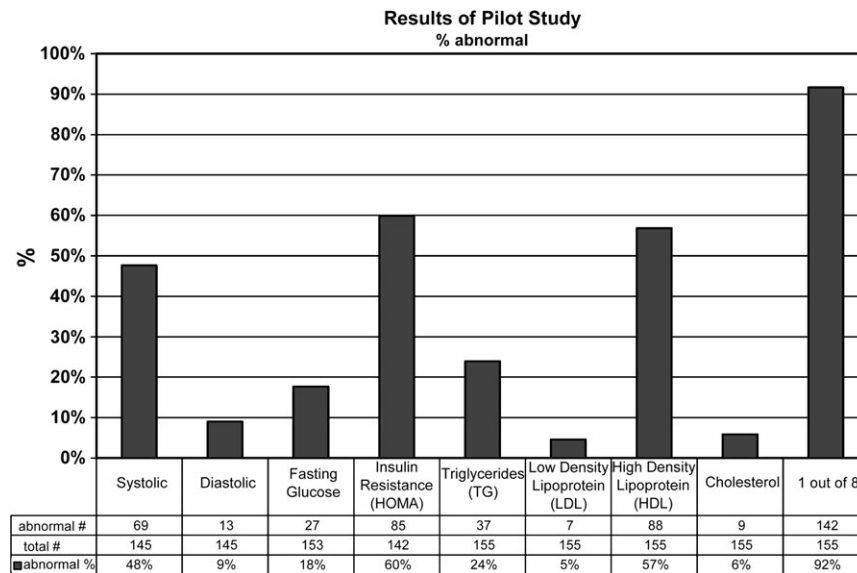


FIGURE 1 Results pilot study Poli X, Meander Medical Centre Amersfoort

Discussion

The results confirm a substantial prevalence of co-morbidity in obese children and give an indication of what can be expected from a surveillance of the general practice population. In other countries, similar studies have been conducted with comparable results, although often different populations and cut-off points were used. An important experience was that the protocol was accepted by the patients and their parents. Although we did not measure it explicitly, the health care professionals involved, also showed enthusiasm for this project.

The German study of Reinehr *et al.*⁴ indicates that 70% of all the obese children suffered from at least one cardiovascular risk factor. In this group (4–18 years old), 37% of the children had hypertension, 27% a high total cholesterol and 26% a high LDL-c and 26% a low HDL-c.

Li *et al.*⁵ studied the relative risk on dyslipidaemia, hypertension, diabetes mellitus and the metabolic syndrome in obese children in relation to normal weight children in China. The relative risk for dyslipidaemia in obese children was 1.8 and for hypertension 2.9. The metabolic syndrome was diagnosed in 83.3% of the obese children. The review article of Amemiya *et al.*¹² indicates that the metabolic syndrome in children and adolescents has become prevalent in the recent years. They found a high variation in prevalence of youth metabolic syndrome. This variation can be partly explained by the lack of standardization in the definition of anthropometric variables and difference in cut-off points used in the studies.

The pilot study forms the basis for a prospective study in 2008. Obese children who will be recruited by GPs (Group 1, $n = 50$) or by youth health care (Group 2, $n = 50$) to the Poli X will be studied. The principal

objective of this study is to assess the prevalence of co-morbidity in obese children in general practice in The Netherlands. A control group of normal weight children in general practice (Group 3, $n = 50$) will be included. The same protocol will be used as in the pilot study. We will try to validate, a non-invasive, diagnostic instrument enabling GPs to detect high-risk obese children in the daily practice. For this reason, a waist circumference measurement and a bioelectrical impedance analysis will be added to the examination of the obese children (Groups 1 and 2) (Bio impedance Analyzer Model BIA 101; Akern Srl, Florence, Italy).

Our pilot study has revealed some important issues requiring special attention in the prospective study. To choose cut-off points for the pilot study was difficult. In this study, we used the cut-off points defined by Poli X. Since there was no consensus about the diagnosis of metabolic syndrome in children, we did not include the syndrome in the pilot study. We decided to use the recent published definition of the International Diabetes Federation¹³ for metabolic syndrome in children in our prospective study (Table 3). This article was published after we finished our pilot study. The HDL cut-off point in this definition is lower than the one we used in our pilot study. Maybe that is an explanation for the high percentage of children with an abnormal HDL. The CBO consensus was finished after we conducted the pilot study. In this protocol, the QUICKY (quantitative insulin sensitivity check index) has been chosen as a measure for insulin resistance.

We will add a QUICKY to the Poli X protocol. In the prospective study, we will study the relation of co-morbidity with age, cardiovascular risk factors in the family and ethnicity. In this study, we found for instance a higher percentage of co-morbidity in Dutch-born children in spite of a lower mean BMI-SDS.

TABLE 3 The IDF definition of the at-risk group and MetS in children and adolescents¹³

Age group (years)	Obesity (WC)	Triglycerides	HDL-c	Blood pressure	Glucose or known T2DM
6 to <10	≥90th percentile	MetS cannot be diagnosed, but further measurements should be made if there is a family history of MetS, T2DM, dyslipidemia, CVD, hypertension and/or obesity.			
10 to <16	≥90th percentile or adult cut-off point if lower	≥1.7 mmol/l	<1.03 mmol/l	Systolic ≥130 mmHg or diastolic ≥85 mmHg	≥5.6 mmol/l (or known T2DM) (if ≥5.6 recommend an OGTT)
16+	Use existing IDF criteria for adults ¹⁴				

IDF, International Diabetes Federation; WC, waist circumference; HDL-c, high-density lipoprotein cholesterol; MetS, metabolic syndrome; T2DM, type 2 diabetes mellitus; CVD, cardiovascular disease; OGTT, oral glucose tolerance test.

In summary, we have found a high percentage of co-morbidity in obese children in our pilot study. If the prevalence of this co-morbidity is as high in the group obese children who are sent by GP to Poli X (Group 1) and significantly higher than in normal weight children (Group 3), it will be a strong argument for GPs to implement the national CBO guideline.

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Declaration

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Conflicts of interest: None.

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